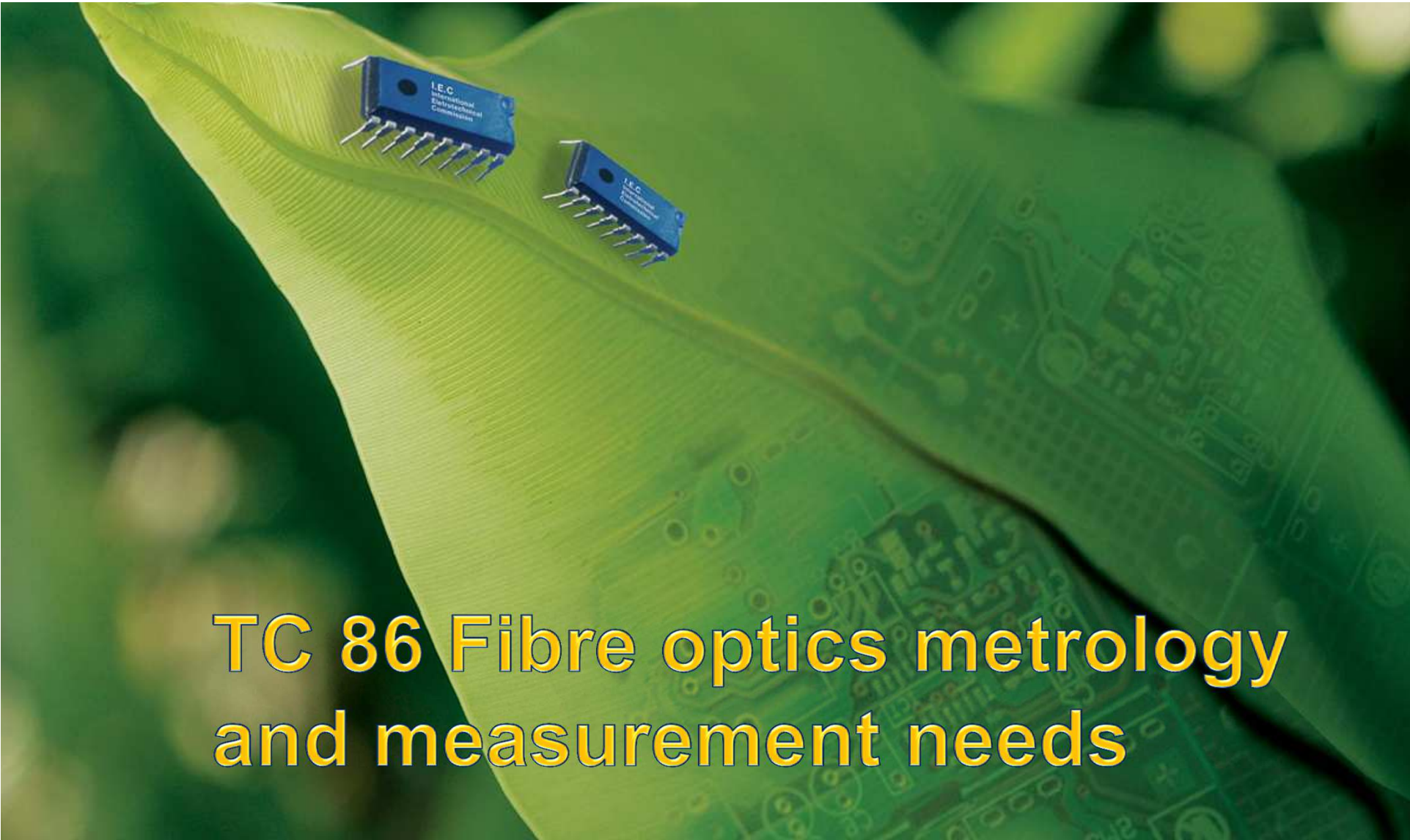




TC 86 Fibre optics metrology and measurement needs

Michel Bouquain
VIAVI Solutions / IEC TC 86 Chair



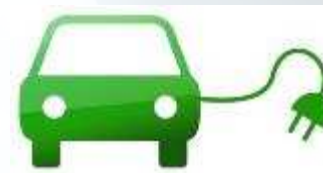
September 19, 2016: CCPR WG-SP, Workshop on Metrology needs in fibre optics



IEC:
International
Electrotechnical
Commission

IEC Mission

- Leading platform for Standards and Conformity Assessment Systems
- Facilitate international trade and enhance user value
- Encourage national adoption of International Standards
- Ensure technical and market relevance



global knowledge platform

20 000 experts

> 174 TC/SCs

7 000 International Standards



=



A satellite map of the world, showing the continents and oceans. The map is oriented with North at the top. The text is overlaid on the map, with the title on the left and the statistics on the right.

The strength of the IEC: 167 countries

83 members + 84 affiliates
98% of world population
96% of electricity generation

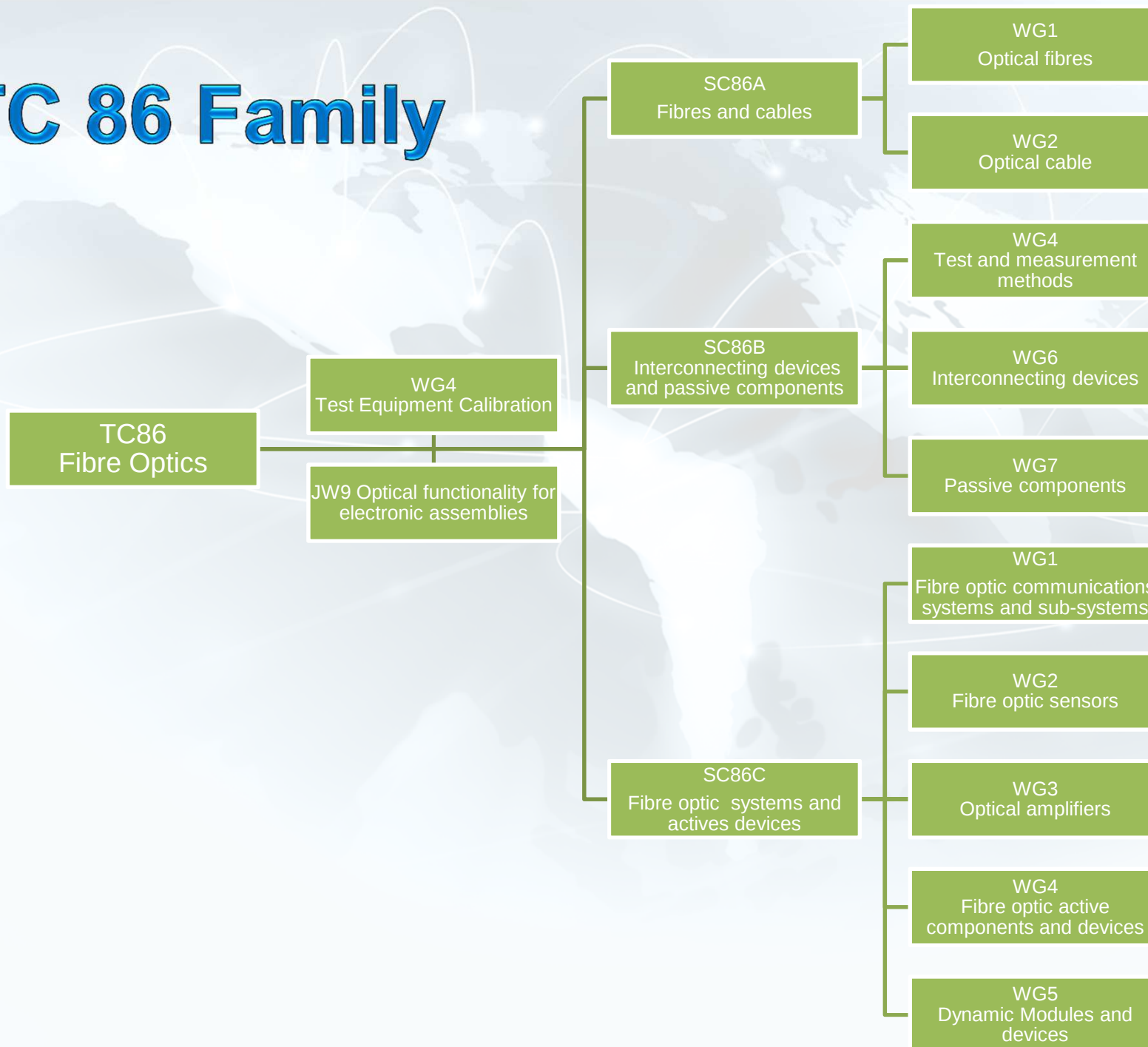
TC 86: Fiber Optics



TC86 Scope

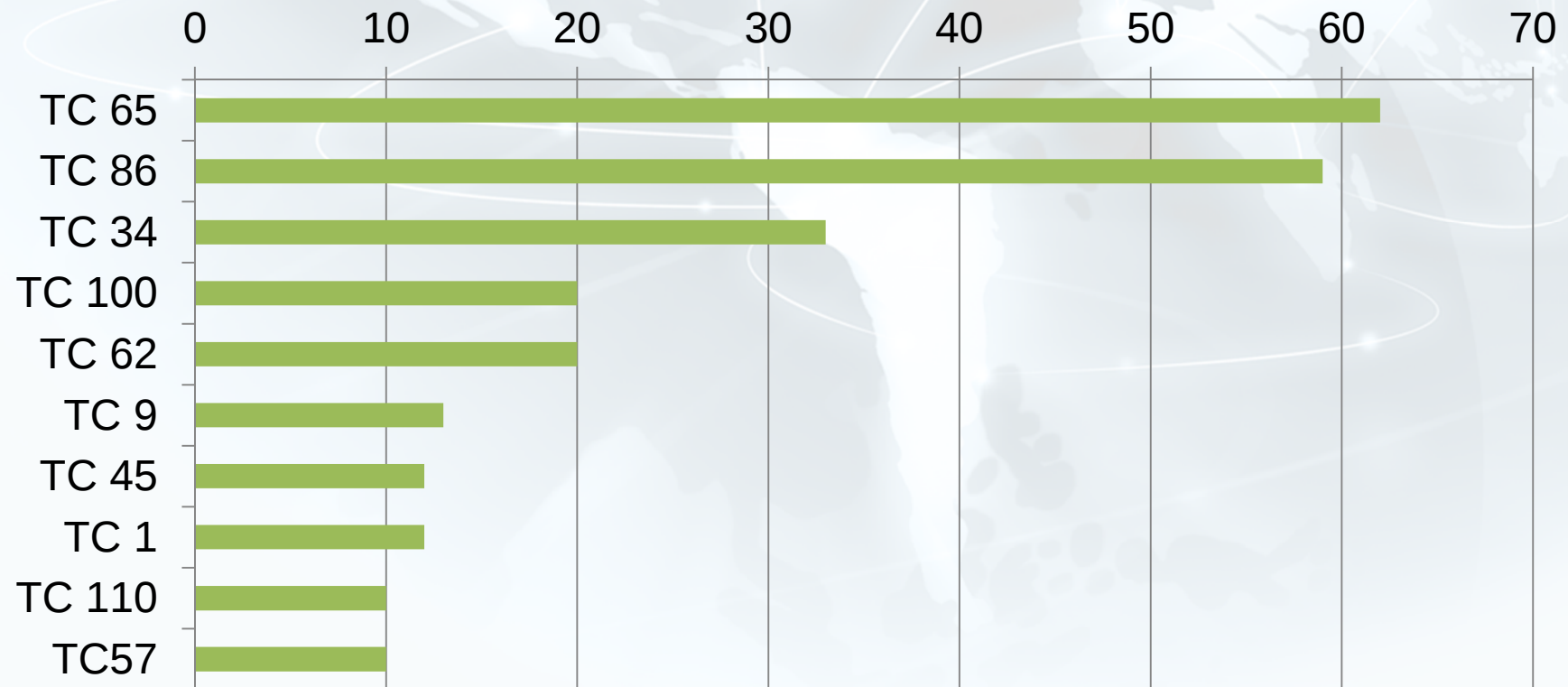
- “To prepare standards for fibre optic systems, modules, devices and components intended primarily for use with communications equipment.”
- This activity covers terminology, characteristics, related tests, calibration and measurement methods, functional interfaces, optical, environmental and mechanical requirements to ensure reliable system performance.”
- **Broad application spectrum** (TLC, Testing & instrumentation, Structured cabling, Transportation, Automotive, Sensors, Military, Industrial automation,)

TC 86 Family



TC86 productivity (Number of published documents - 2014)

- TC 86 is always in top three



TC86: Fiber Optics

- **Chairman: Michel Bouquain (France)**
- **Secretariat: U.S.A.**
 - Secretary: **Steven E. Swanson**
 - Assistant Secretary: **Elaina Finger**
- *Harmonize approach across the whole TC*
 - **WG4: Fiber optic test equipment calibration**
 - Test equipment calibration (OPM, OTDR, OSA etc.)
 - Cooperation with metrology laboratories worldwide
 - **JWG9(with TC 91): Optical functionality for electronic assemblies**
 - Optical circuits and optical boards
 - Interconnection of equipment frames and cards

TC86: Calibration Documents

- **Calibration of fibre-optic power meters:** [IEC 61315:2005*](#)
- **OTDR**
 - Calibration of optical time-domain reflectometers (OTDR) - Part 1: OTDR for single mode fibres: [IEC 61746-1:2009](#)
 - Calibration of optical time-domain reflectometers (OTDR) - Part 2: OTDR for multimode fibres: [IEC 61746-2:2010](#)
- **Calibration of fibre optic chromatic dispersion test se:** [IEC 61744:2005](#)
- **End-face image analysis procedure for the calibration of optical fibre geometry test sets:** [IEC 61745:1998*](#)
- **Wavelength / frequency measurement:**
 - Calibration of wavelength/optical frequency measurement instruments - Part 1: Optical spectrum analyzers: [IEC 62129-1:2016](#)
 - Calibration of wavelength/optical frequency measurement instruments - Part 2: Michelson interferometer single wavelength meters: [IEC 62129-2:2011](#)
 - Calibration of wavelength/optical frequency measurement instruments - Optical frequency meters using optical frequency combs: [IEC 62129-3:2014](#)
- **Calibration of tuneable laser sources:** [IEC 62522:2014](#)

* under revision

TC86: Reports

- Fibre optic communication system design guides - Part 14: Determination of the uncertainties of attenuation measurements in fibre plants: [IEC TR 61282-14:2016](#)
- Fibre optic interconnecting devices and passive components - Part 04: Example of uncertainty calculation: Measurement of the attenuation of an optical connector: [IEC TR 62627-04](#)

These two documents are based on GUM (JCGM100:2008), please avoid too significant changes.

TC 86 is seeking close connection with GUM editors.

Metrology need for measurement devices

- **Fibre-optic power meters**
 - **Calibration uncertainties (for customer)**
 - Low end : 6%
 - High end : 3% → need for 2%
 - **Calibrated wavelengths**
 - CDWM applications require : 1270 to 1610 nm (20 nm steps)
 - PON applications require : many discrete wavelengths in CWDM range
 - MM applications require : 850 to 950 nm
 - **Overall need for OPM manufacturers:**
 - Calibration uncertainties in range of 1% (2σ) at all wavelengths in range 700 to 1700 nm by steps of 10 nm @ -20 dBm
- **OSA / Wavemeter**
 - **Calibration uncertainties needs for manufacturers (easily available):**
 - OSA 200 pm (2σ)
 - Wavemeter 0.2 pm (2σ)

SC 86A, SC 86B, SC 86C

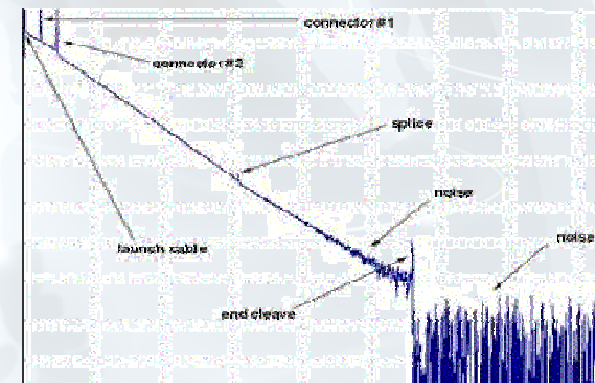
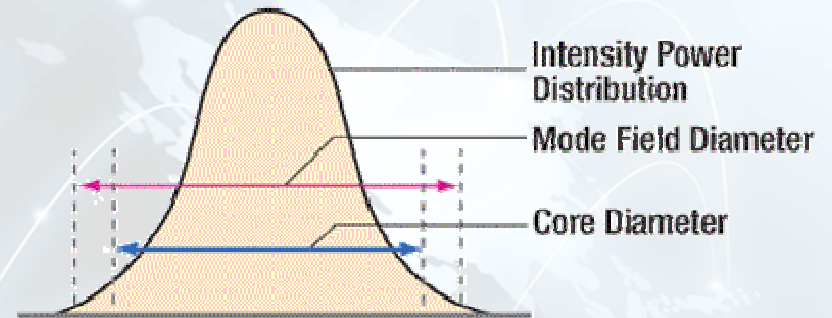


SC86A: Optical Fibers and Cables

- **Chairman: Gerard Kuyt (Netherlands)**
- **Secretariat: France**
 - Secretary: **Guy Perrot**
- **WG1: Fibres and associated measuring methods**
 - Harmonization with ITU-T G.65x (recommendations)
 - Test methods for all types of optical fibres and for all fibre parameters (geometrical, mechanical, optical and environmental)
 - High-performance BI MM fibres for high-speed links (private networks, cabling systems, LAN, data centres, industrial cabling)
 - POF (Plastic Optical Fibres)
- **WG3: Optical fibre cables**
 - All types of cables (external, internal, aerial, underground, underwater, etc.)
 - Test methods for cables (mechanical, optical, environmental, etc.)
 - MDU optical cables (FTTH)
 - Installation techniques
 - Harmonization with ITU-T L-series - recommendations (outside plant)

Challenges: SC86A

- Measurement of mode field diameter (SM)
- Measurement of core diameter (MM)
 - Better control of performance
- Analysis of OTDR traces
 - Manufacturing cost saving
- Bend insensitive fibers
 - Interconnection compatibility



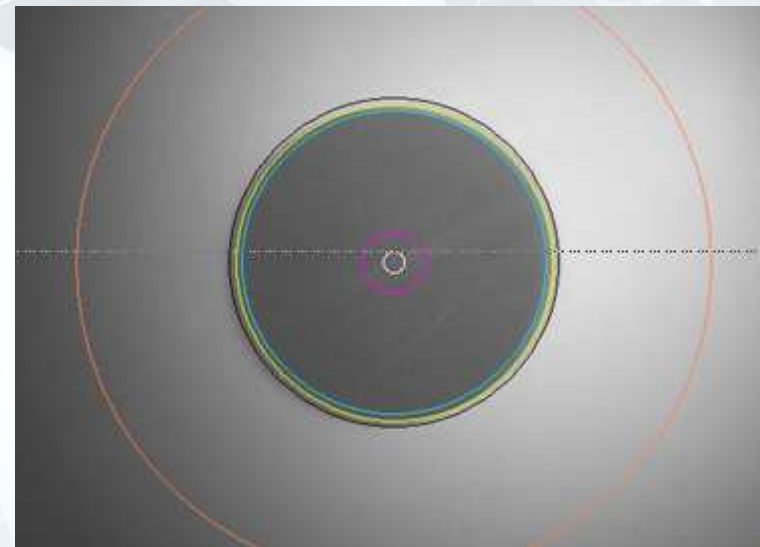
SC86B: Interconnecting Devices and Passive Components

- **Chairman: Daniel Daems (Belgium)**
- **Secretariat: Japan**
 - Secretary: **Shigeru Tomita**
- **WG4: Tests and measurement methods**
 - Inspection, test and measurements of connector ferule end face
 - Connector performance (geometrical, mechanical, optical and environmental parameters)
 - Launch conditions for MM optical fibres
- **WG6: Interconnecting devices and related components**
 - Performance of interconnection optical components
 - Interface standards for connectors and adapters
 - “Related” components (accessories, closures, patch-panels, etc.)
- **WG7: Fibre optic passive components**
 - WDMs, passive couplers , passive components for PONs and FTTHEffective and strong cooperation with ITU-T Q. 7/15

Challenges: SC86B

Challenges:

- **Reference grade connector**
 - Reduce attenuations measurement errors
- **Connector end face inspection**
 - Improve automatic pass and fail inspection
- **Better knowledge of measurement uncertainties**
 - Improve passive components specifications



SC86C: Optical Systems and Active Devices

- **Chairman: Haruo Okamura (Japan)**
- **Secretariat: U.S.A.**
 - Secretary: **Jack Dupre**
- **WG1: Communications systems and sub-systems**
 - Specifications, design methodology, and test methods for physical layer of optical fiber communication systems and sub-systems
 - Installed MMF cable plant measurements with controlled launch conditions based on “encircled flux” method
 - Characterization of quality of vector-modulated signals with error vector magnitude
 - In service optical signal-to-noise ratio definitions and measurement
 - In service measurements

SC86C: Optical Systems and Active Devices (Cont'd)

- **WG2: Optical sensors**
 - Kick-off meeting in November 2012
 - 54 Experts, 15 NCs
 - General specification 61757-1 on Fiber Optic Sensors published
 - Strain sensors using Fibre Bragg Gratings (IEC 61757-1-1)
 - Distributed temperature sensors (IEC 61757-2-2)
 - General structure of Fiber Optic Sensors Standards agreed
 - Planned: IEC 61757-2-1 Temperature measurement - Temperature sensors based on fibre Bragg gratings
- **WG3: Optical amplifiers**
 - Specifications and related test procedures for relevant parameters of optical amplifiers
 - All type of optical amplifiers: doped-fibre, Raman, and semiconductor types (with WG4)
 - New: high-power, four-wave mixing, Raman amplification

SC86C: Optical Systems and Active Devices (Cont'd)

- **WG4: Active components and devices**
 - Covers: Optical Tx, Rx, Transceivers, Modulators, etc.
 - Packaging, performance, interface and reliability standards
 - Test procedures (optical, mechanical, vibrations, etc.)
 - Optical transceivers
- **WG 5: Dynamic modules and devices**
 - For monitoring and dynamic control of optical signal characteristics
 - (gain equalizers, ROADMs, PMD and CD compensators, etc.)
 - Performance and interface standards (even SW!), test procedures, reliability, etc.

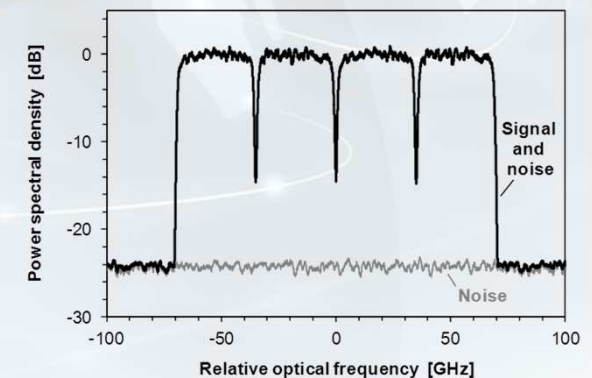
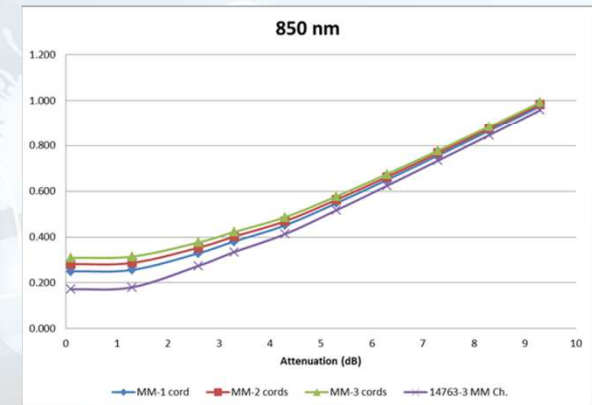
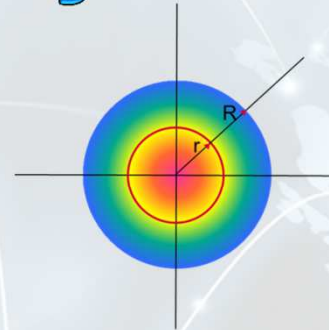
SC86C: Optical Systems and Active Devices

WG1: Challenges

- **MMLC** & Measurement uncertainties
 - Reduce needs for attenuation margins of fiber links
- **In service OSNR**

WG2: Challenges

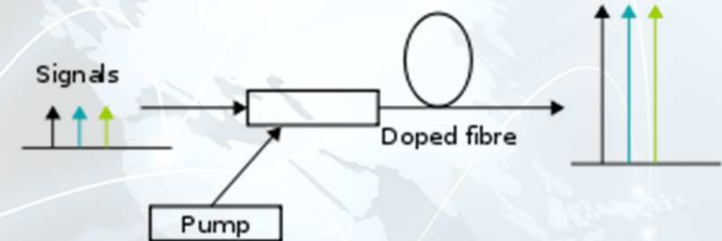
- Performance of sensors **and metrology**



SC86C: Optical Systems and Active Devices

WG3: Challenges

- **Burst mode amplifiers**
- **High power amplifier measurement**



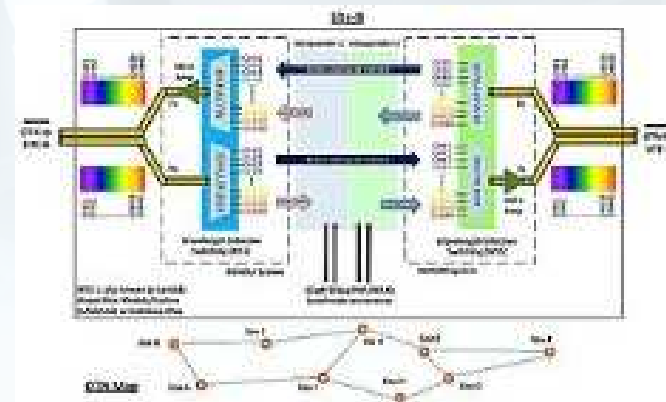
WG4: Challenges

- **Package for PIC (Photonic Integrated Circuits)**
- **Measurements**



WG5: Challenges

- **New dynamic modules for ROADM**



TC86 subcommittees: Summary of metrology needs

- Mode field (SM) and core (MM) diameter measurements
- OTDR trace analysis (try to avoid both direction measurements)
- Interconnectivity of bend insensitive fibers (SM and MM)
- Reference grade connector
- Reproducibility of automatic connector end face inspection
- Multimode launch conditions (EF)
- In service OSNR
- Metrology of distributed fibre sensor
- PIC measurements methods
- From amplifiers: high power and burst power measurements

Thank you



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for you.

